William H. Johnson
Senior Vice President
Federal Regulatory and Legal Affairs
1300 I Street, NW
Suite 500 East
Washington, DC 20005
202.515.2492
will.h.johnson@verizon.com

September 16, 2019

Marlene H. Dortch
Secretary, Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

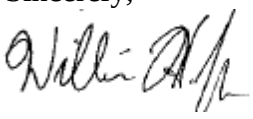
Re: Expanding Flexible Use of the 3.7 to 4.2 GHz Band, GN Docket No. 18-122

Dear Ms. Dortch:

On September 12, 2019, Bill Stone, Vice President of Technology Development & Planning of Verizon, and I met with Nick Degani, Senior Counsel to Chairman Ajit Pai. Separately, Greg Romano, Patrick Welsh, Bill Stone, Scott Townley, Philip Junker, and Ratul Guha, representing Verizon, met with the following staff from the Office of Engineering and Technology and the Wireless Telecommunications Bureau: Julie Knapp, Don Stockdale, Bahman Badipour, Kenneth Baker, Michael Ha, Barbara Payon, Matthew Pearl, Paul Powell (by phone), and Janet Young (by phone).

During the meetings, we discussed Verizon's technical proposal, detailed in the attached presentation, to protect operations of incumbent earth stations in a re-purposed C-Band. We urged the Commission to move quickly to free up critical mid-band spectrum for wireless use, while protecting incumbent earth station operations through our proposal.

Sincerely,



Attachment

cc: Nick Degani
Julie Knapp
Don Stockdale
Bahman Badipour
Kenneth Baker
Michael Ha
Barbara Payon
Matthew Pearl
Paul Powell
Janet Young

Protecting C-Band Earth Stations

An Alternative Approach

12 September 2019

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Objective.

Maximize the initial and ongoing utility of MBX in C-Band, while fully protecting earth stations.

Place the burden of interference management on the operator, not on the equipment.

Flexible regulatory scheme so that any future reallocations minimize

- Standards work
- Equipment replacement
  - Base station TX filters
  - End-User Equipment

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Table of contents

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Limiting Out-of-Band Emissions.

Placing the responsibility of interference management on the base station/end-user equipment reduces the utility of any C-Band allocation.

Example: Qualcomm Band n48 submission states that to meet -40 dBm/MHz OOBE requires a 11.5 dB A-MPR (Additional Maximum Power Reduction) for end-user equipment.

- Halves the cell coverage radius/distance

Certain base station implementations (e.g., FD-MIMO) have TX filtering implemented at the subarray level.

- A changing upper band edge (e.g., with continued incremental clearing) means rip-and-replace with each change.

Serves no purpose in suburban or rural areas where there is no FSS receive station nearby.

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An Alternative Approach.

Adopt 3GPP Band n77 as the template for C-Band MBX.

3300-4200 MHz

- While clearly this is outside of the MBX allocation, operators will adhere to their allocated blocks. Network signaling instructs the end-user devices where to go within the band.
- Additional US-only 3GPP band classes are thus not required.

-13 dBm/MHz OOBE (both end-user and base station)

Adopt the CBA's proposed Receiver Protection Thresholds as a guideline.

-59 dBm aggregate blocking (in-band MBX, out-of-band FSS)

-128 dBm/MHz (out-of-band MBX, in-band FSS)

Advantages:

MBX equipment is not overly constrained in areas far from FSS receive stations

Harmonization with a worldwide 5GNR allocation; no need for (multiple) US-only band definitions.

Consistent with the philosophy of Dynamic Spectrum Sharing and flexibility to change guideline over time.

Network Management Techniques.

MBX operators are responsible for *locally* modifying their networks in the vicinity of FSS receive stations to meet the Receiver Protection Thresholds.

No need to *artificially* limit OOBE when not operating near FSS receive stations.

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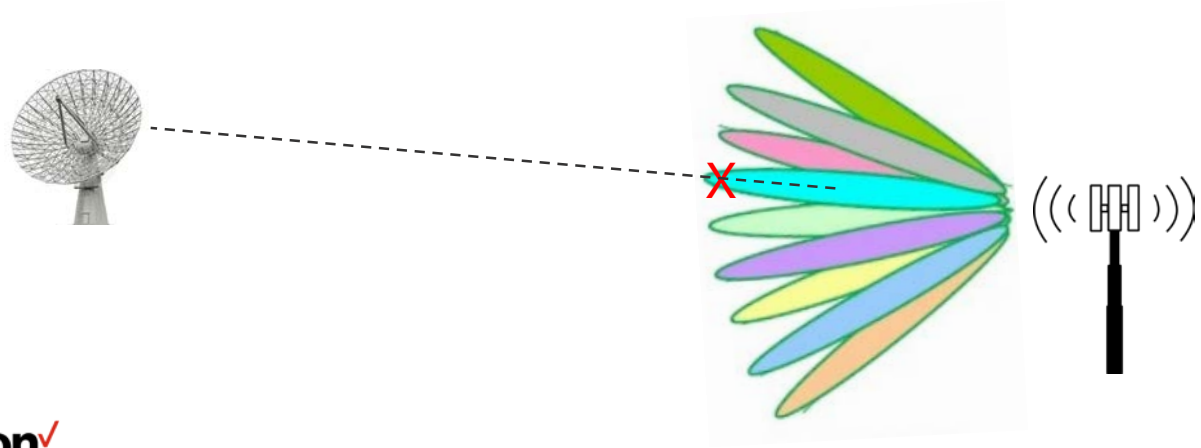
Beam Omission.

A multiple beam antenna can provide 25-30 dB rejection in a 10 degree field-of-view by omitting one of the constituent beams.

Mitigates blocking and base station OOBE. Local UEs would move to another band with better signal strength.

The associated wavelength enables this implementation.



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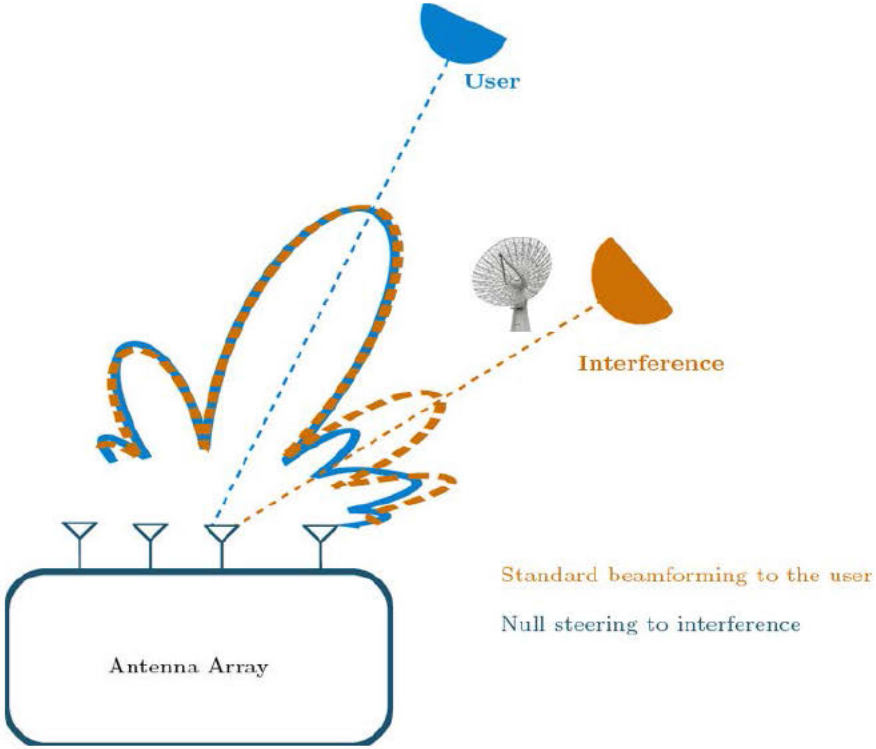
Zero-Forcing.

FD-MIMO systems are designed to “force” pattern nulls in the direction of other-user interference.

In this case, the azimuthal angle towards the FSS receive station is permanently defined in software as an “interferer”.

Impact similar to that of the Beam Omission technique in the blocking case.

Again, the associated wavelength enables this implementation.



Other Techniques.

Fractional Power Control.

3GPP defines a power control scheme that gives the operator control over the maximum UE transmit power allowed, as well as the functional relationship of UE transmit power vs. path loss to the serving base station, on a per-transmitter basis.

- Reducing UE transmit power will result in *at least* a dB-for-dB reduction in UE OOBE.
- Note that due to linearity requirements, most UEs meet -30 dBm/MHz OOBE out-of-the-box.

Local picocell deployment.

Deploying a low-power picocell right at the FSS receive station gives even greater control over UE transmit power and OOBE.

- Picocell can be custom-configured to prevent blocking the FSS receiver.
- Due to their proximity, UEs will transmit at nearly their minimum transmit power.

Receiver Protection Thresholds

The proposed Receiver Protection Thresholds should be held as flexible guidelines.

Experience may show the Thresholds (and the 40 km management zone) to be conservative.

Equipment upgrades at the FSS receiver (e.g., improved LNBs) may permit locally-relaxed thresholds.

Guiding Philosophy: Observations at the FSS receiver provide the actionable criteria.

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Determination of Interference Condition

Reportable FSS interference is:

- Observed impairment in video quality, and
- A decrease in the FSS receiver-measured C/N by more than 0.5 dB against an established basis.
  - 0.5 dB decrease in C/N is the assumption underlying the derivation of the -128 dBm/MHz threshold.

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Apportioning the Receiver Protection Thresholds

Receiver Protection Threshold powers should be apportioned to multiple licensees based upon each licensee's proportional licensed bandwidth within a particular FSS receive station management zone.

$$RXThreshold_i = \frac{\sum_{i,j} LicensedBandwidth}{\sum_j LicensedBandwidth}$$

Where i denotes the licensee and j denotes the licensed geographies within the FSS receive station management zone.

Ensuring Rapid Response to ES Interference

Verizon proposes that the MBX community establish a Joint Rapid Response Clearinghouse (JRRC) call center to respond immediately to interference trouble tickets from earth station operators.

MBX licensees will jointly establish a single phone number and/or e-mail address available to registered earth station operators 24 hours a day, 7 days a week, 365 days a year.

Upon ticket receipt at the JRRC, all identified licensees within 40 km of the affected earth station would be notified and mobilized immediately.

All licensees would be required to take proactive provisional steps to mitigate possible interference as soon as possible while the issue is being researched and addressed.

After the interference is resolved, normal operations will resume and the impacted MBX licensees will coordinate to determine and document the root cause to minimize the likelihood of recurrence.

The current 850 MHz Public Safety/C-NII interference reporting system could be a model.

TT&C/Gateway Earth Station Operations

Placement of a TT&C earth station in a small town does not necessarily minimize its impact on MBX licensees.

TT&C is a co-channel interference case. The required FSS-MBX isolation is as high as 65-(-128)=193 dB for a single base station.

Any TT&C in the Northeastern US could impact tens of millions of pops and multiple major metropolitan centers.

TT&C operations should not impact major population centers.

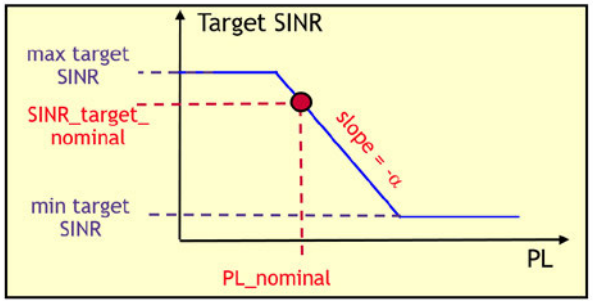
Backup

Fractional Power Control

3GPP 38.213 defines UL power control procedures.

A variety of parameters are available that enable operators to set for each sector:

- Maximum allowed UE transmit power
- Rate at which UE transmit power varies with distance/path loss
  - The maximum rate is 1 dB UE TX per 1 dB path loss. Lower (“fractional”) rates are allowed.
- Maximum RX SINR at the base station



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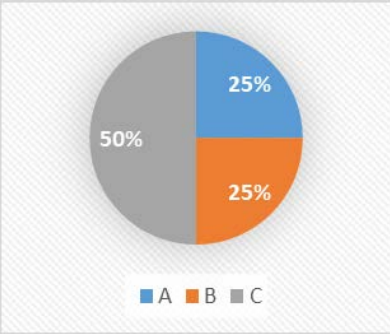
Receiver Protection Threshold Apportionment

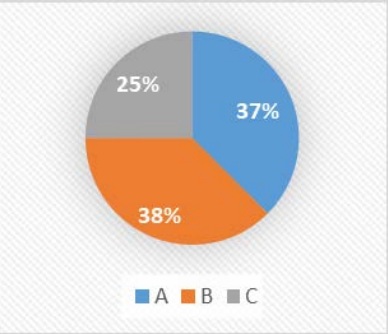


RX management zone entirely within Licensed Geography 1

25% = -6 dB

50% = -3 dB

RX management zone entirely within Licensed Geography 2



RX management zone spans Licensed Geographies 1 & 2

37.5% = -4.3 dB

These reductions would apply to both FSS out-of-band (blocking) and FSS in-band thresholds

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